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IMPACT OF CLEAN WATER INFRASTRUCTURE TO INCOME INEQUALITY, WITH ECONOMIC GROWTH AS INTERVENING

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Abstract: The purpose of this study is to examine the relationship between clean water infrastructure development and income inequality. From a panel dataset year 2011 to 2018, this study uses clean water infrastructure development, Economic growth, and path analysis as independent variables to observe the effect on income equality. Statistically, clean water infrastructure development does not affect income inequality, directly nor indirectly. Economic growth does not affect income inequality. The insignificant result may be caused by the short length of time. The results of this study do not intend to suggest policymakers reduce clean water infrastructure development. Policymakers should apply a distribution policy by considering the needs and potential of the community to make the development more valuable.

Keywords: *Economic Growth, Income Inequality, Clean Water Infrastructure*

1. Introduction

Income inequality experienced by Indonesia currently needs attention. Based on data from the Central Statistics Agency, the Population of the poor in March 2020 was 26.42 million (9.78%), increasing 1.63 million (0.56%) from September 2019. On the other hand, many conglomerates lived in Indonesia. According to Forbes quoted by Liputan6.com December 2019, the wealthiest people in Indonesia have a net worth of Rp526 trillion. Furthermore, The World Bank (2016) reports that 10 percent of it consumes as much as 54 percent of the poorest people in 2014. It indicates that income inequality still deserves attention.

The National Medium-Term Development Plan 2020-2024 explains that one of the strategic issues of reducing inequality is the low level of basic needs fulfillment. The problem comes from the supply side (low service coverage and healthy water providers) and the demand side (low awareness of people for clean and proper water, willingness to pay, and water-saving behavior).

The Indonesian government needs to improve these conditions to meet welfare distribution. As explained in the National Medium-Term Development Plan of the Republic of Indonesia 2020-2024, the government prioritizes the development of basic service infrastructure to reduce inequality between regions. Hopefully, the fulfillment of water service infrastructure will influence economic growth and income inequality, in line with the infrastructure development agenda.

Several studies have been done before. Sukwika (2018) found that equitable infrastructure development, including clean water, reduces income inequality. It supports the

explanation that investment will create jobs. Furthermore, clean water infrastructure provision also plays a role in advancing society's welfare, which will increase productivity. clean water infrastructure increases people's interest to live and then carry out their economic activities in the area. This can benefit low-income residents to be able to carry out economic activities, have income for daily life, and eventually can improve their welfare.

Based on the explanation above, we can see a correlation between clean water infrastructure and income inequality. On this basis and to analyze the government of Indonesia's policies on infrastructure development, this study is trying to identify the relationship between clean water infrastructure development and income inequality in Indonesia with economic growth as an intervening variable.

Thee Kian Wie (1981, quoted in Hartono, 2008) divides income inequality from an economic perspective into three, (1) size distribution income, that is the inequality of income size distribution between residents; (2) urban-rural income disparities, that is the inequality of income distribution between urban and rural areas; (3) regional income disparities, that is the inequality of income distribution between region in a country.

Based on some references, infrastructure gives different results on income inequality. Hooper et al., (2018) found that infrastructure has a negative correlation to the Gini ratio. As the rate of infrastructure in one area increases, the ratio and thus income inequality decreases. Other works of literature are Sukwika (2018) and Gibson & Rioja, (2014) that conclude that equal distribution of infrastructure can reduce income inequality. On the other hand, Makmuri (2017) concludes that some public investment in infrastructure tends to increase income inequality. His research uses index of road, telecommunication, electricity, and airport infrastructure to assess the effect to the income inequality.

Many factors could influence Income inequality. One of those is access to infrastructure. Infrastructure benefits the rural area by giving them access to more economic activities (Bajar & Rajeev, 2016). To support the activities, the community needs a clean water supply. An area with good quality of water supply will be more attractive for businesses to make an investment, which later creates jobs for society. Furthermore, clean water infrastructure can also influence inequality by saving society money. The cost of water from a vendor is more expensive than the cost charged by the public utility.

On the other hand, economic growth seems to be related to income inequality. Kuznets Hypothesis explains that there is a relationship between income inequality and economic growth. This hypothesis stated that when development starts to grow, income inequality will increase. But when it reaches a certain point of income, inequality will decrease. The mechanism regarding the Kuznets phenomenon originates from the idea that there is a transfer of labor from low productivity and inequality level regions to high productivity and inequality level regions. (Yasa & Arka, 2015) found that Kuznets Hypothesis is proven. However, (Nazipawati, 2019) found that Kuznets Hypothesis is unproven.

Many researchers found that clean water infrastructure development affects economic growth. Aminah (2017), and Atmaja & Mahalli (2015) studied the effect of clean water infrastructure's impact on economic growth. Those studies conclude that clean water infrastructure development will positively affect economic growth. (Nugraha et al., 2020) conclude that clean water infrastructure affects economic growth positively in Indonesia. Furthermore, (Frone & Frone, 2011) also found a positive correlation between public water supply and economic development in Romania. Lastly, Purba & Budiono (2019) studied 500

districts and cities in Indonesia and concluded that water infrastructure supports economic activities and opens new jobs. Hence, it will influence economic growth. Meanwhile, previously Prasetyo (2008) found contradicting results. It found that clean water infrastructure does not affect economic growth in western Indonesia.

2. Research Method

The research object of this study is income inequality in Indonesia. The data are obtained from the Central Bureau of Statistics from 2011 to 2018 of 32 provinces in Indonesia, excluding East Kalimantan and North Kalimantan. It is because North Kalimantan, which was part of East Kalimantan, was just established in 2012. Therefore, this study uses panel data regression with 32 provinces as observation group and 2011-2018 as time series.

The dependent variable of this study is income inequality, which uses the Gini ratio as the proxy. Gini ratio measures the level of inequality using a scale of 0 (fully equal) to 1 (fully inequal). As the independent variable, water infrastructure development is measured by the amount of piped water distributed from the water provider per 1000 people. As the mediating variable, Economic growth uses the proxy Gross Regional Domestic Product per capita.

This research uses education level, health level, and inflation rate as control variables. The chosen variables were following the study from Bajar & Rajeev (2016). It says that the provision of health and education services can reduce poverty, and thus reduce inequality (Bajar & Rajeev, 2016). Education level is measured as the average length of the school, taken from the Central Statistics Agency. Meanwhile, the level of health is measured by the number of doctors (general, specialist, dentist, and dental specialist) per 100,000 population, taken from Publications of the Ministry of Health. The last control variable is the inflation rate which is adopted from Makmuri (2017). This variable tries to accommodate macroeconomic instability factors in the model. The inflation rate is measured as the general average of inflation in major cities in each province. All of the data are obtained from the Central Statistics Agency.

Everyone needs clean water for their health. If clean water is easily accessible for the community, their health and quality of life will be maintained. This will maintain community productivity in running the economy. Therefore, the development of clean water infrastructure is expected to have an impact on economic growth. Based on these reasons, the following hypothesis is formulated:

H1: Clean water infrastructure development affects economic growth

Availability of access to clean water can improve economic activity through GDP, and therefore could affect income inequality. In addition, the rate of GDP is also expected to affect income inequality. The level of education, the level of health, and inflation rate are approximated to influence income inequality. Therefore, those variables are included in the model as control variables. Based on these reasons, the following hypothesis is formulated:

H2: The development of clean water infrastructure affects income inequality mediated by economic growth

Control variables are part of the independent variables, which function to make the regression model more proper. This variable aims to strengthen the influence of the

independent variable on the dependent variable studied (Sugiyono, 2016). In the multiple linear regression equation, the control variables have the same treatment as other independent variables, but these variables are not included in the hypothesis and discussion. The control variables in this study are the inflation rate, education level, and health level.

A. Inflation Rate
The inflation rate is measured using the general average of inflation in major cities in each province expressed as a percentage. The inflation rate describes the macroeconomic conditions in a region. The use of this control variable was also carried out in Makmuri (2017).

B. Education Level
The level of education is measured using the average length of schooling of the population in each province expressed in years. The level of education describes the social services provided by the government. The provision of social services by the government can impact the poor through health and education. Improving education and health is considered a good tool for reducing social (Bajar & Rajeev, 2016).

C. Health Level
Health level is measured by the number of doctors (both general practitioners, specialists, dentists, and specialist dentists) who have a Registration Certificate per 100,000 population. As the level of education, the level of health is a description of the social services provided by the government, and improving health is considered capable of reducing people's welfare (Bajar & Rajeev, 2016).

The Theoretical Model for these studies is as follow:
Model 1

$$GDP_{it} = \beta_{0it} + \beta_1 Wa_{it} + \beta_4 Ed_{it} + \beta_5 He_{it} + \beta_6 In_{it} + \varepsilon$$

Model 2

$$Gini_{it} = \beta_{0it} + \beta_1 GDP_{it} + \beta_2 Wa_{it} + \beta_5 Ed_{it} + \beta_6 He_{it} + \beta_7 In_{it} + \varepsilon$$

$$Gini_{it} = Income\ Inequality\ (Gini\ Ratio)$$
$$GDP_{it} = Economic\ Growth\ (GDP)$$
$$Wa_{it} = Clean\ Water\ Infrastructure\ Development$$
$$Ed_{it} = Level\ of\ Education$$
$$He_{it} = Level\ of\ Health$$
$$In_{it} = Inflation\ Rate$$

3. Results and Discussion

3.1. Results

According to Chow Test, Breusch-Pagan Lagrangian Multiplier Test, and Hausman Test, the two models are referring to as Fixed-Effect Model.

Classical Assumption Test

This study has tested both models for normality. The result shows that the distribution of residuals of the theoretical model 1 and the theoretical model 2 is not normal. To fix the problem, each data variable is transformed. The result is shown below.

Table 1. Transformation Result

Variable	Transformation
Gini	Log
GDP	1/(*square root*)
Wa	Log
In	*square root*
Ed	Log
He	1/(*square root*)

Source: Processed Data

The second test is the multicollinearity test. The result shows that both models have multicollinearity, where the value of VIF is above ten. It can be solved by using a centering method for each variable.

The third and the fourth test, heteroscedasticity, and autocorrelation, have been done as well. Based on the results, these show that both theoretical models have heteroscedasticity and autocorrelation. Those can be solved by using a regression model with Driscoll and Kraay standard errors, which are heteroskedasticity consistent and robust to general forms of cross-sectional (Hoechle, 2007).

Model 1

The regression test for theoretical model 1 shows that the R-squared is 0.8284. It indicates that independent variables in theoretical model 1 can explain 82.84% of the variation of economic growth, while 17.16% is explained by other factors outside the model. The regression test also shows that theoretical model 1 has a probability value of 0.0000. It means all the independent variables significantly and simultaneously affect the dependent variable.

Another information which is shown by the regression tests is partially significant. The summary of the regression is shown in Table 2.

Table 2. Regression Result of Model 1

GDP	Coef.	Drisc/Kraay Std. Err.	t	P>|t|	[95% Conf. Interval	
Wa	-.0000887	.0000628	-1.41	0.201	-.0002371	.0000598

Source: Processed Data

Table 2 shows that the probability value of the clean water infrastructure variable is 0.201. The result shows that clean water infrastructure development doesn't significantly affect economic growth. This result contradicts the previous study from Aminah (2017), Atmaja & Mahalli (2015), Nugraha et al. (2020), Frone & Frone (2011), and Purba & Budiono (2019). On the other hand, this result confirms the study done by Prasetyo (2008). The result also contradicts the proposed theory that clean water infrastructure development affects economic growth positively. Several reasons for this contradictory result allegedly because many people still use groundwater instead of piped water as a main source of clean water. Certain people that cannot access the piped water still can access the substitutes from other sources.

Model 2

A regression test had been done to the theoretical model 2 as well. It shows that the R-squared is 0.2307. It indicates that independent variables in theoretical model 2 can explain 23.07% of the variation of income inequality, while the rest 76.93% is explained by other factors outside the model. It also shows that theoretical model 2 has a probability value of 0.0000. It means that Economic Growth and clean water infrastructure simultaneously influence income inequality. However, the result for the partial test did not show significance to income inequality. The partial test regression result of theoretical model 2 is shown in Table 3.

Table 3. Regression Result of Model 1

Gini	Coef.	Drisc/Kraay Std. Err.	t	P>|t|	[95% Conf. Interval	
GDP	3.018872	10.71064	0.28	0.786	-22.30776	28.34551
Wa	.0100575	.0052866	1.90	0.099	-.0024434	.0225585

Source: Processed Data

According to Table 3, we can see that the probability value of the GDP variable is 0.786. It shows that we cannot prove that economic growth affects Gini Ratio. This finding contradicts the finding of Yasa & Arka (2015). This finding cannot also prove the proposed theory, that is economic growth affects income inequality negatively. This contradiction is thought to be due to the time lag on the effect of economic growth on income inequality. Economic growth allegedly needs a longer time to affect income inequality.

In Table 3 the probability value shows that clean water infrastructure development does not affect the Gini Ratio, which contradicts the result of Sukwika (2018). It also contradicts the proposed theory, in which clean water infrastructure development affects income inequality negatively. This contradictory result is allegedly due to the time lag on the effect of clean water infrastructure development on income inequality. A previous study done by Hooper et al. (2018) uses 10 years lag to identify the effect of infrastructure development on income inequality. Due to the limited data, this study uses only one year lag.

3.2. Discussion

From the result, we can see that the independent variable, clean water infrastructure development, does not affect the mediating variable, economic growth. The result confronts the theory that clean water infrastructure can increase economy in one area. People who do not consume clean water from water companies can get their substitutes from several sources, such as well water, river water, and bottled mineral water. Thus, it can be stated that there is not enough evidence to explain the effect of clean water infrastructure development on economic growth.

We can also find that the mediating variable does not affect the dependent variable, income inequality. This result is different from the proposed theory that economic growth influences social inequality. This difference is thought to be due to the time lag on the effect of economic growth on social inequality. Economic growth is thought to take longer to significantly affect social inequality. Due to data limitations, this study only uses a time lag of one year. Thus, it can be concluded that there is not enough evidence to explain the effect of economic growth on social inequality.

Based on the results, we can conclude that there is no indirect effect between clean water infrastructure and income inequality with economic growth as a mediating variable. In other words, economic growth does not mediate the effect of clean water infrastructure development on income inequality. This finding contradicts Nugraha et al. (2020) which stated that infrastructure, including clean water, reduces income inequality indirectly through economic growth. It is suspected that it will take a longer time to determine the social impact of air infrastructure. Hooper et al. (2018) in their research used a time lag of ten years. Due to data limitations, this study only used a one-year lag time. Therefore, it can be said that there is not enough evidence to explain the social impact of air infrastructure development.

4. Conclusion

This paper could not find enough evidence to prove that clean water infrastructure development will reduce income inequality in Indonesia, using the time given. There are two main explanations for this finding. First, the fact that there are still many people who use groundwater as the main source of their clean water. A group of people that cannot access the piped water still can access the substitutes from other sources. Hence, the piped water developments are not the only source of clean water, so they cannot determine the economic growth and income inequality well. Second, there is an allegation that clean water infrastructure and economic growth need a longer time to influence income inequality. Like other policies in general, it needs more than 2-5 years to see its impact. Hooper et al. (2018) use 10 years lag in their study. We could not provide the lag due to limited data.

The results of this study do not intend to suggest policymakers reduce clean water infrastructure development. Policymakers should apply a distribution policy by considering the needs and potential of an area to make the development more valuable. Policymakers should also consider the aspect of equity when drawing up a development plan, not only for growth.

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